"A Conceptual Framework for Sustainable Tourism Development through Sustainable Practices in the Hotel Sector in Bangladesh"

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ABSTRACT

The study, "A conceptual framework for sustainable tourism development through sustainable practices in the hotel sector in Bangladesh" addresses the urgent need to mitigate climate change impacts through sustainable practices in the hospitality industry. Tourism contributes significantly to global greenhouse gas (GHG) emissions. This study explores how renewable energy adoption can promote energy efficiency in the Bangladeshi hotel sector, aligning with global efforts to combat climate change.

The primary objective is to develop a framework for sustainable hotel operations that reduces GHG emissions and supports climate change mitigation. Specific objectives include examining the role of tourism in addressing global warming and identifying practical renewable energy applications for hotels to enhance energy efficiency.

Using a qualitative descriptive methodology, the research relies on secondary data, including literature reviews, policy analyses, and reports. The findings emphasize the potential of renewable energy systems, energy-efficient designs, and net-zero strategies in transforming traditional hotels into sustainable establishments. The study also highlights the importance of stakeholder collaboration, operational improvements, and guest engagement in achieving these goals.

The proposed framework outlines actionable strategies such as integrating energy management systems, retrofitting buildings, implementing on-site renewable energy production, and fostering water and waste management practices. These measures not only reduce operational costs but also position the hotel sector as a leader in sustainable tourism development.

In conclusion, this study offers a roadmap for hotels in Bangladesh to adopt renewable energy and energy-efficient practices, contributing to global sustainability goals while addressing the environmental challenges posed by tourism.

Five keywords relevant to the study: 1. Sustainable Tourism Development 2. Renewable Energy Integration 3. Energy-Efficient Hotels 4. Climate Change Mitigation 5. Net-Zero Strategies

These keywords align with the study's focus on sustainability, renewable energy, and environmental impact reduction in the tourism sector.

Objectives of the Study

Primary Objective

The study "A conceptual framework for sustainable tourism development through sustainable practices in the hotel sector in Bangladesh" will develop a guideline on steps to be taken to mitigate impacts of climate change in hotel sector of Bangladesh and reduce global warming.

Specific Objectives

- Discuss about role of Tourism Sector in reducing global warming.

- Identify steps to take to make hotels more energy efficient.

- Develop a conceptual framework to make hotels more energy efficient.

This study will help tourism sector of Bangladesh to reduce greenhouse gas emission and contribute to reduce global warming.

METHODOLOGY

This study has been conducted by using a qualitative descriptive method obtaining data from primary and secondary sources.

This study is descriptive type. Here secondary data are use to address the objective of the study. The necessary data from secondary sources has been collected through document analysis. For this purpose, a thorough literature survey has been conducted. In order to obtain the reliable secondary data various journals, periodicals, books, acts, regulations, policies of Bangladesh, websites, annual reports, papers of different agencies were consulted carefully.

In this study, the method of data analysis is adopted based on the necessary information collected on measures to be taken for mitigation of climate change. After collecting the data, a comprehensive analysis has been made for understanding of climate change, role of tourism organizations to mitigate climate change, discussion on net zero concepts and how to implement the net zero in hotels and managerial activities will be examined. Finally, using descriptive method, the results of these studies are compiled and the practical solutions are consequently provided.

Primary sources:

Personal observation and knowledge.

Secondary sources

Online journal and article, Text books, newspaper, official documents. A variety of online resources also has been used for the research.

LITERATURE REVIEW

A comparatively small number of studies examine the relationship between tourism and energy use and support the direct implications of tourism on the environment and climate change. However, the relationship between energy use, climate change, and economic growth is currently receiving more attention. In order to reduce the energy sector's impact on environmental degradation, other studies emphasize the necessity of effective energy forecasting. Travelers from nations with greater awareness of energy and climate change are more likely to select renewable energy sources and more energy-efficient infrastructure.(12)

The link between energy use, climate change and economic growth is now attracting more attention (17), a relatively minor number of studies focus on the impact of tourism on energy use and support the direct implications of tourism on environment and on climate change (2).

Other studies highlight the need for efficient energy forecasting when seeking to mitigate the contribution of the energy sector to environmental degradation (10). Tourists from countries with higher energy and climate change awareness tend to choose more energy-efficient infrastructures and renewable energy sources (10)

The globalization process, known for building socioeconomic partnerships across countries, is also charged with

encouraging environmental degradation through the Environmental Science and Pollution Research over-consumption of natural resources and energy consumption, deforestation, land erosion, and weakening (4). While studying the causality of environmental degradation in Pakistan, empirically confirmed the existence of a significant connection between CO2 emissions and GDP growth, renewable energy, technological innovation, and globalization. (3) suggested using solar energy as a source of economic intervention to control CO2 emissions and improve environmental quality in China. The danger of air pollution is hard to escape as microscopic air pollutants pierce through the human respiratory and cardiovascular system, injuring the lungs, heart, and brain. Ill-planned and uncontrolled human activities negatively affect ecosystems, causing climate change, ocean acidification and melting of Ice (2).

However, no researchers have conducted in the field of tourism showing Net Zero method for hotels in Bangladesh.

So, this study will shed light in actions to be taken to achieve sustainable tourism development target by utilizing sustainable strategy in hotels of Bangladesh.

Sustainable Tourism Development Concept

The World Tourism Organization defines sustainable tourism as tourism which leads to management of all resources in such a way that economic, social and aesthetic needs can be filled while maintaining cultural integrity, essential ecological processes, biological diversity and life support systems (14).

If right measures are taken, tourism industry can be a positive force for both the environment and the local economy. Sustainable Tourism aims to reduce poverty by creating local jobs and stimulating local business, while establishing ecologically sustainable practices that preserve resources and reduce pollution. At present only a very small amount of tourism profits touches the people living in and near tourist destinations.(8) Increasing local involvement can not only generate income but also encourage communities to protect their environment from further degradation.

If tourism organizations like hotels Invest in energy efficiency and waste management can reduce GHG emissions and pollution and also save hotel owners and service providers' money. If appropriate action taken, natural areas, biodiversity, and cultural heritage—three of the main reasons people travel in the first place—can all reap the benefits of sustainable tourism. (11)

Tourism organizations of Bangladesh particularly hotel sector need to think and act sustainably to mitigate climate change impact.

Climate Change Mitigation Measures for Hotel Sector

According to ITP-Hotel Global Decarburization Report (5) published in November 2017, steps for evolving to the next-generation thinking about sustainability to mitigate climate change and achieve science-based targets, hotels and the hotel industry will need to advance their technological solutions and their organizational approach to the topic.

ITP-Hotel Global Decarburization Report (5) suggestions to reducing carbon will need to be:

The efforts required achieving a 66% reduction by 2030 and a 90% reduction 2050 can be categorized into three viable methods:

More efficient

More renewable

More electrified

More efficient:

Pursuing the highest and most innovative levels of efficient technology, furniture, fittings and equipment (FF&E), and best practice operations; designing highly efficient buildings, engaging guests to be more efficient, and optimizing the best solutions for carbon reduction through efficiency pathways.

Increasing efficiency of equipment and operations:

This is already becoming a common practice, but needs to catalyze new innovation as it arises, and is insufficient to achieve significant reduction amid industry growth alone. Along with external grid efficiency, energy efficiency has been the cornerstone of hotel carbon reduction achievements in the past two decades. New technologies have emerged and scaled-up, and new operational practices have become common. Moving forward, energy efficiency will need to evolve to incorporate:

• **Higher efficiency:** e.g. efficient lighting (LED light bulbs) and HVAC

• **Build for efficiency**: new builds and retrofits will need to be as efficient as possible, and designed for future efficiency upgrades as they arise.

• **Guest efficiency:** opportunities can be explored to engage the guest to be efficient in the most sensible places.

New efficiency: making more use of new technologies beyond the most frequently used ones: efficient lighting, variable frequency drives, boiler/chillier upgrades,-and-occupancy-sensors.

• **Carbon efficiency:** The potential for carbon reduction needs to be embedded in the analysis and planning. For example, if two energy efficiency projects can both achieve a 20% return on investment (ROI) but one is for reducing natural gas usage (a 5% carbon reduction) and the other electricity usage (a 10% carbon reduction), then the electricity efficiency project should be-prioritized.(13)

More renewable:

Producing and sourcing more renewable energy directly on-site at properties, procuring energy from partners in innovative agreements, and supporting the acceleration of power grids toward renewable and away from fossil fuels.

Increasing the prevalence of renewable energy

The hotel industry will need to accelerate the use of renewable energy for its own direct use on-site, as well as support utilities in their acceleration of transitioning the power grid toward renewable:

• **On-site renewable**. Wind power, solar power, ground sources of heating and cooling, and bio-fuels will need to be transitioned into the hotel's energy production for electricity generation and HVAC.

•**Near-site Renewable.** This term is used here to differentiate from directly generated onsite or offsite purchases from utilities, and denotes the opportunities for hotels to purchase energy from third parties separate from the utility grid (or as a para-utility partner) in purchase power agreements (PPAs), or community solar projects.

Supporting utility renewable: Hotels can support utilities to transition to decarburization through Renewable Energy certificates (RECs) and Green Tariffs with premiums embedding renewable, along with other guest engagement mechanisms.

More Electrified:

Taking necessary steps for transition to electrification of equipment, and building an infrastructure to generate,

store, and distribute electricity over a network.

Increasing 'Electrification'

Electrification will become an essential component of hotels achieving science based targets, and increasingly important as the concept of net-zero buildings becomes-more-prevalent:

• **Electrifying equipment.** Hotel facilities will need to shift to electric-driven chillers (already the most common). However, large opportunities also exist in heating which will need to be accelerated (e.g. the Suntec Singapore Convention Centre's recent conversion of the kitchen to all-induction appliances).

• **Storing electricity.** Hotels will need to install batteries for buildings. Commercial building battery technology for storing electricity on-site will become more scalable and viable. Hotels will be able to embed storage of energy as part of the strategy towards low-carbon solutions as well as energy cost-savings.

Pathway for hotels to align with the Paris Agreement for mitigating climate change

While the movement towards 'net zero' has evolved over the past year, the hotel sector first tackled decarburization at the industry level through The Global Hotel Decarburization Report (9) which was published by the Sustainable Hospitality Alliance (formerly International Tourism Partnership) in 2017.

The report states that in order to keep pace with the requirements of a 2-degree scenario, and taking into account the industry's growth trajectory, the global hotel industry will need to reduce its Greenhouse Gas (GHG) emissions per room per year by 66% from 2010 levels by 2030 and by 90% by 2050.

Since the publication of this document, a number of hotel companies have set science based targets and others have announced net-zero commitments. In addition, Tourism Declares a Climate Emergency was launched in 2020 as a campaign to galvanize support from the tourism sector, including hotels, for setting reduction targets in line with the Paris Agreement.

Definition for ZEB given by The U.S. Department of Energy (DOE) Building Technologies Program:"A net zero-energy building (ZEB) (6) is a residential or commercial building with greatly reduced energy needs through efficiency gains such that the rest of energy needs will be available from renewable sources."

Transforming Existing Hotels in to Net–Zero Hotel

Hotel development across the world is growing rapidly; in developed world recent years have seen enthusiastic adoption of sustainable design principals focused on reducing the operational energy use of these new buildings. But existing hotel properties have continued operating and their energy efficiency and consumption have been largely ignored.

Most of the existing hotels were established the era of climate awareness and is operating with significantly lower energy efficiency and higher consumption levels than is currently considered acceptable.

It is very much important to adapting and retrofitting existing buildings to lower GHG emissions is critical and needs to be embraced as part of the hotel sector's "Route to Zero Carbon" (10).

Hotels have a part to play

Research by Natural Climate Change (19), published in 2018, found that tourism's global carbon footprint was four times higher than previously estimated, accounting for about 8% of global greenhouse gas emissions.

According to a research conducted by the Sustainable Hospitality Alliance (18)found that the hotel industry needs to reduce its carbon emissions by 66% per room by 2030, and by 90% per room by 2050 so that the growth in the industry does not increase carbon emissions.

Steps to be taken to turn Conventional Hotels into Net Zero Hotels:

According to UK Green Building Council's (UKGBC) 'Net Zero Carbon Buildings: A Framework Definition (6) to define the scope of net zero for the hotel sector.

Net zero carbon operational energy: When the building's annual carbon emissions related to its operational energy are either zero or negative. A net zero carbon building is extremely energy-efficient and runs entirely on renewable energy sources, either on- or off-site, with any leftover carbon balance offset.

Energy use and sources:

The best approach to achieve net zero carbon in operation is to move away from fossil fuels and reduce energy consumption. The majority of traditional hotels use energy in the following ways:

- The swimming pool and hot water for the hotel rooms are heated by gas-fired boilers.

- Electricity for fans, air conditioners, small power, lighting, and guest room heating and cooling (using a variable refrigerant flow system).

– Gas and electric combined for food production equipments.

Walls, windows, roofs and floors

A significant proportion of energy used to maintain comfort escapes through the building envelope. Understanding modern thermal overall performance is a key first step to assessing the ability blessings of enhancing walls, windows, roofs and floors.

Carbon Removal Strategy

Carbon Removal Strategy suggested by Net Zero Methodology for Hotels (First Edition)(18): -

Move-Towards-Efficiency

The most cost effective and, arguably, easiest way to reduce the carbon emissions of the hotel is to improve how it is managed.

Significant savings can be made without altering the structure of the hotel or its building services – from how rooms are booked, to when you cool and heat the spaces.

Control and monitoring of Activities

Building management system (BMS)

A centralized BMS allows hotel operators better control and monitoring of their building. It can reduce energy consumption and also allow you to identify and respond to faults with the heating and cooling systems before guests complain. (7)

Metering

Smart metering or networked sub-metering, mixed with software, also can be an essential device to maximize electricity performance.

Guestroom management

A modern guest room management system, integrated with building arrangement, property management, and other systems provides a holistic view of each guest room in the hotel. These systems manage electricity consumption, permitting motel operators to discover and proactively cope with protection needs, facilitate

provider requests, and permit troubleshooting issues remotely.

An efficient guestroom control machine detects and responds to the presence of guests, permitting heating or cooling to be decreased whilst rooms are unoccupied.

Allocate rooms close together for the guests

A hotel room allocation based on guest preference and availability, without taking energy optimization into consideration. As a result, lighting in circulation spaces, mini bars, heating and cooling were running throughout guestroom blocks unnecessarily. Occupancy varies through the year, ranging from around 65% in low season to over 90% in peak season. There are positive impacts of different approaches to allocating rooms: by block, by orientation and by level. Allocating rooms together has other operational benefits. For example, cleansing and service workers have less distance to walk and regions may be closed off for maintenance.

Hot water and heating for swimming pool

To reduce evaporation and condensation, pool halls are kept above the water temperature of the pool. The Pool Water Treatment Advisory Group recommends that pool hall air temperature should normally be maintained at the water temperature or within 1°C. However, air temperatures over 30°C should generally be avoided.

Using pool covers and allowing the pool hall temperature to drop overnight to around 19°C generated a further 4% energy saving While achieving net zero carbon ultimately means switching from gas, upgrading those old boilers to a more modern version might lessen annual electricity intake and reduce carbon emissions and costs.

Air source heat pumps

Rather than a VRF (variable refrigerant flow), system, it may be suitable to use a polyvalent heat pump. During the summer, heat extracted from rooms could then be put into the warm water tanks and swimming pool, enhancing heat pump efficiency.

Retrofitting this to the existing system would require wholesale replacement of all fan coil units (FCUs), inflicting foremost disruption inside rooms, even though it may be phased over time.

This system also has the advantage of significantly reducing refrigerant use. These are powerful greenhouse gases, so the lifecycle carbon effect of such systems is significantly lower than for VRF, when starting from new.

Catering

The kitchen is another key focus area for changes to ways of working. Accounts for about a fifth of the energy consumption and carbon emissions in a hotel

Incremental improvements to guestrooms

– Thermal performance of walls and windows.

– Air tightness.

– Wall to window ratios in various orientations.

– Lighting efficiency and daylight control.

– Internal and external solar shading..

Insulation

In the hotels much of the focus on reducing heating demand for buildings has been on improving insulation and

air tightness.

Air tightness

In any building, low levels of air leakage reduce heat lost to or gained from outside. In turn, this cuts energy use and carbon emissions associated with heating and cooling. Reducing air leakage significantly can reduce energy consumption.

Glazing and daylight

Consider the balance between day lighting, solar gains and artificial lighting before developing the façade treatment.

The ratio of window to wall on the hotel room changes heat loss, solar gain and reduces electric lighting requirements.

Solar shading, like internal blinds, can reduce unwanted summer solar gain.

Showers

Hot water can be efficiently produced using ground or water source heat pumps. In summer, heat recovery system is very efficient.

Fittings can reduce the volume of water supplied at the outlet. The impact of introducing low-flow shower heads, may reduce hot water consumption significantly.

Shower wastewater heat recovery provides an opportunity to considerably reduce the amount of hot water heating required. This system recovers and uses wastewater heat from showers to preheat cold water and can reduce energy required significantly.

Lighting

Replacing luminaries and controls

Hotel may consider installing intelligent panel boards for automated lighting control with room sensors, to improve the efficiency of their hotel properties. (10) The payback for LED lamps at 12 years appears very high, but this is because the calculation has not taken account of the fact that compact fluorescent and halogen light bulbs have much shorter life spans at about 15,000 hours and 2,000 hours respectively compared to 50,000 with LEDs.

Catering busy hotel kitchens often yield a very short payback for replacing old equipment with more energy efficient, newer equipment. Transitioning away from fossil fuels, catering equipment will become primarily electric.

Ventilation heat recovery

A run-around coil system, reclaiming 55% of the heat extracted from the kitchen, based on the ventilation rate during use, and using it to preheat water for washing up.

As part of a major kitchen refurbishment, where the ventilation system requires replacing or significant modification, ventilation heat recovery can be installed. Ventilation heat recovery is efficient when used to preheat hot water supply for the kitchen.

Induction cooking

Induction units generate very little wasted heat, as energy is directly applied to pots and pans, although these must be specifically for induction, which can make them more expensive. However, the reduction in wasted heat

means cooler kitchens, more comfortable staff and less additional cooling need.

Suggestions for Sustainable Energy Use for Hotels in Bangladesh

Specific suggestions for integrating renewable energy into hotels in Bangladesh (20), (21), (22),(23)

On-Site Renewable Energy Production

- Solar Panels: Install photovoltaic panels on rooftops or open spaces for electricity generation.

- Solar Water Heating: Use solar thermal systems to provide hot water for guest rooms, pools, and spas.

- Biomass Systems: Utilize organic waste for energy production to power kitchens and heating systems.

Energy-Efficient Retrofits

- Insulation: Upgrade building envelopes with improved insulation and air-tight materials to reduce energy loss.

- Lighting Systems: Replace traditional lighting with LED fixtures and smart lighting controls.

- HVAC Systems: Introduce energy-efficient heating, ventilation, and air conditioning systems powered by renewable sources.

Operational Strategies

- Energy Storage Solutions: Install batteries to store excess renewable energy for peak-demand periods.

- Smart Building Management Systems (BMS): Implement IoT-based systems to monitor and optimize energy use in real-time.

- Guest Awareness: Educate guests about energy-saving measures through in-room displays or digital apps.

Collaborations and Partnerships

- Community Solar Projects: Partner with local solar initiatives to procure renewable energy.

- Green Energy Certifications: Obtain Renewable Energy Certificates (RECs) to validate sustainability claims.

Government Incentives

- Advocate for policy support, such as tax rebates or subsidies, for renewable energy projects in the hospitality sector.

Research and Pilot Programs

- Conduct pilot projects in select hotels to assess the feasibility and ROI of renewable energy technologies.

Conceptual framework for more energy efficient hotels

The hospitality industry is a significant consumer of energy, making energy efficiency a critical component in promoting sustainable tourism. Drawing on data from various secondary sources, this conceptual framework outlines strategies and practices designed to enhance energy efficiency within the hotel sector. By implementing these guidelines, hotels can reduce their energy consumption, lower operational costs, and contribute to the global effort of sustainable tourism development.
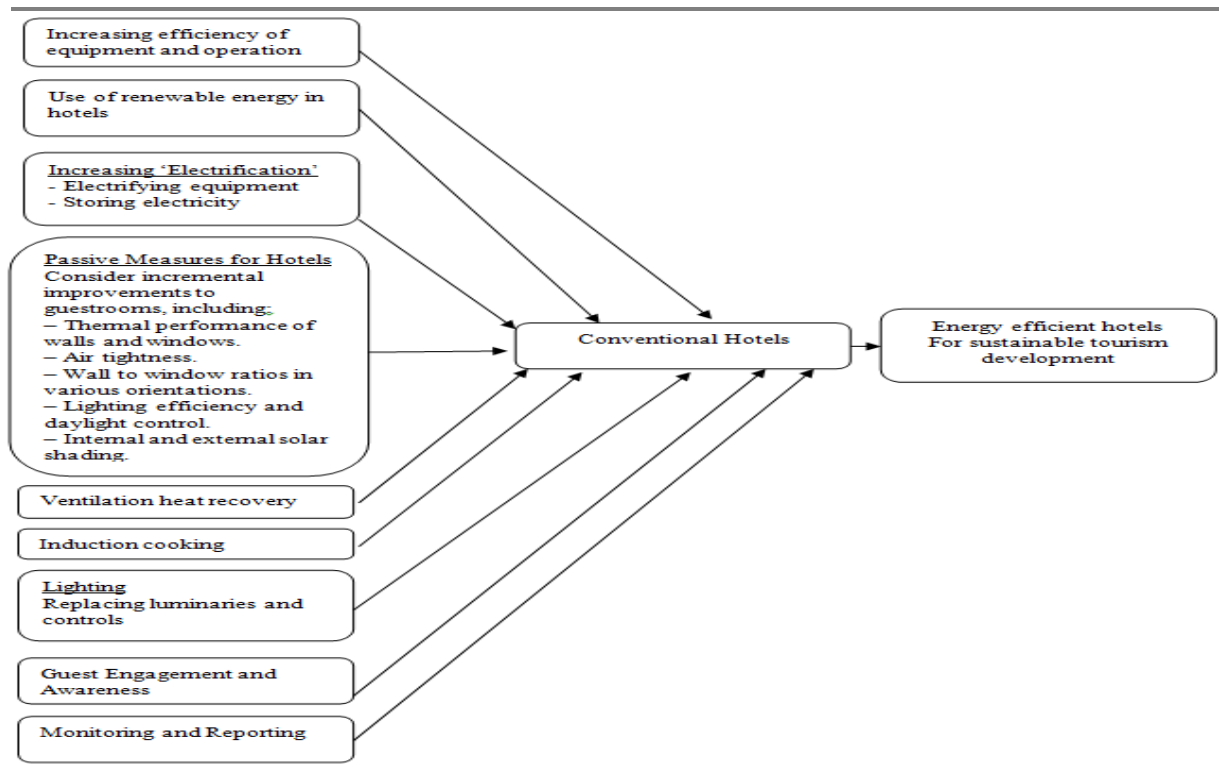
Figure 1: Conceptual framework

DISCUSSION ON CONCEPTUAL FRAMEWORK FOR ENERGY-EFFICIENT HOTELS

By adopting this conceptual framework, hotels can significantly reduce their energy consumption and environmental footprint. This transition not only aligns with global efforts to combat climate change but also positions the hotel sector as a leader in sustainable tourism. Through strategic investments, innovative practices, and stakeholder engagement, the hospitality industry in Bangladesh and abroad can drive meaningful change and contribute to a more sustainable future.

Key Elements of the Framework

Energy Management Systems (EMS)

- Implementation of Smart Technology: Install advanced energy management systems that monitor, control, and optimize energy usage.

- Utilize IoT-enabled devices to automate lighting, heating, and cooling based on occupancy patterns.

- Deploy AI-driven analytics to predict energy demands and improve operational efficiency.

- Centralized Monitoring: Establish centralized building management systems (BMS) to oversee energy consumption across facilities, detect inefficiencies, and enable real-time adjustments.

Building Design and Retrofitting

- Energy-Efficient Architecture: Integrate passive design principles such as:

- Proper insulation and thermal barriers to reduce heating and cooling demands.

- Maximized natural ventilation and daylight to decrease reliance on artificial lighting and HVAC systems.

- Retrofitting Older Buildings:

- Replace outdated equipment with energy-efficient alternatives, such as LED lighting and high-performance HVAC systems.

- Upgrade windows with double glazing to improve thermal performance and reduce energy loss.

- Incorporate green roofs and reflective surfaces to mitigate urban heat island effects.

Renewable Energy Integration

- On-Site Renewable Energy Production:

- Install solar panels, wind turbines, or geothermal systems to generate electricity and reduce reliance on fossil fuels.

- Implement biomass systems for sustainable heating solutions.

- Grid and Community Initiatives:

- Participate in power purchase agreements (PPAs) with renewable energy providers.

- Support community solar projects and green tariff programs to encourage broader adoption of clean energy.

Operational Efficiency

- Staff Training and Engagement:

- Conduct regular training sessions on energy conservation practices.

- Create a culture of sustainability by incentivizing employees to contribute to energy-saving initiatives.

- Equipment Maintenance:

- Perform regular inspections and maintenance of equipment to ensure optimal performance and longevity.

- Replace inefficient appliances and systems with energy-efficient models.

Guest Engagement and Awareness

- Educational Campaigns:

- Inform guests about the hotel's sustainability initiatives through signage, brochures, and digital platforms.

- Highlight the environmental benefits of participating in energy-saving programs, such as opting out of daily linen changes.

- Incentives for Eco-Friendly Behavior:

- Offer rewards for guests who participate in sustainability initiatives, such as reduced rates or loyalty points for energy-conscious behavior.

Water Conservation Techniques

- Low-Flow Fixtures and Recycling:

- Install water-saving fixtures, such as low-flow showerheads and faucets.

- Implement water recycling systems to reuse gray water for landscaping and other non-potable applications.

- Rainwater Harvesting:

- Utilize rainwater harvesting systems to reduce dependency on municipal water supplies.

Waste Management and Energy Recovery

- Recycling Programs:

- Establish comprehensive recycling initiatives for paper, plastic, glass, and other materials.

- Composting and Waste-to-Energy Systems:

- Implement composting systems for organic waste.

- Explore waste-to-energy technologies to convert waste into usable energy.

Monitoring and Reporting

- Data-Driven Insights:

- Use smart meters and sensors to track energy consumption and identify inefficiencies.

- Analyze data trends to refine energy management strategies.

- Transparency and Accountability:

- Publish regular sustainability reports to share progress with stakeholders and demonstrate commitment to environmental goals.

Pathway to Implementation

Assessment and Planning:

- Conduct an energy audit to evaluate current consumption patterns and identify areas for improvement.

- Develop a tailored action plan that aligns with the hotel's operational goals and sustainability targets.

Stakeholder Collaboration:

- Engage with government agencies, NGOs, and industry partners to access resources, incentives, and expertise.

- Foster partnerships with technology providers for innovative solutions.

Pilot Programs and Scaling:

- Launch pilot projects to test new technologies and practices in a controlled environment.

- Scale successful initiatives across the hotel's portfolio to maximize impact.

Continuous Improvement:

- Regularly review and update energy management practices to incorporate emerging technologies and evolving standards.

- Solicit feedback from staff and guests to identify new opportunities for improvement.

CONCLUSION

The study "A conceptual framework for sustainable tourism development through sustainable practices in the hotel sector in Bangladesh" underscores the critical need for the hotel industry to embrace sustainable practices, particularly through the adoption of sustainable practices. As the tourism sector in Bangladesh continues to expand, the environmental impact of this growth cannot be overlooked. Hotels, being significant energy consumers, have a substantial role to play in reducing greenhouse gas emissions and mitigating the effects of climate change.

The proposed framework offers a comprehensive approach to enhancing energy efficiency in hotels, which is pivotal for achieving sustainability goals. By integrating energy management systems, retrofitting buildings, incorporating renewable energy sources, and promoting water conservation, the hotel sector can significantly reduce its carbon footprint. Additionally, engaging both staff and guests in sustainability initiatives ensures that the impact of these efforts is maximized.

This study not only contributes to the global discourse on sustainable tourism but also provides actionable insights specific to Bangladesh's hotel sector. The adoption of the outlined strategies will not only help in reducing operational costs but also position Bangladesh as a leader in sustainable tourism in the region. Ultimately, this framework serves as a roadmap for hotels in Bangladesh to transition towards a more sustainable future, aligning with global efforts to combat climate change and promoting a more responsible tourism industry.

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